Section II.—BOTANICAL.

General Characteristics of the Algal Vegetation of Buzzards Bay and Vineyard Sound in the Vicinity of Woods Hole.

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Chapter I.—INTRODUCTION.

Ever since the publication of Harvey's "Nereis Boreali-Americana," in 1852, 1857, it has been recognized that the marine algæ of the Atlantic coast of North America were separated by Cape Cod into two floras. The distinction was discussed in detail in Farlow's report "The Marine Algæ of New England," 1881, and in his earlier "List of the Sea-weeds or Marine Algæ of the South Coast of New England," 1873. The work of later algologists has only served to emphasize the fundamental differences between the two marine floras, and the results of this survey add further evidence in support of this general conclusion.

Similar conclusions have been reached by zoologists respecting the distribution of marine animals north and south of Cape Cod. The fauna from the cape northward to Labrador is regarded as essentially a continuous one, with no changes that are comparable to those which appear southward. Two faunas separated by Cape Cod have thus been distinguished, and there seems to be a difference between these similar to that between the two marine floras. The most important reasons for the difference between the faunas and floras north and south of Cape Cod are undoubtedly the same.

The marine algæ north of Cape Cod, as pointed out by Farlow (1881), are in general a part and continuation of the flora of Greenland and Newfoundland. Many of the most characteristic species of the flora, as judged quantitatively, are identical with those of the Scandinavian coast, and it seems clear that the algæ of the west and east side of the north Atlantic are a part of a general Atlantic boreal flora.

The reason for the boreal character of the algal flora north of Cape Cod is undoubtedly the low range of temperature which prevails even through the warmer months of the year. The coast is bathed by a belt of cold water that lies between the coast and the Gulf Stream, this belt being from 200 to 250 miles broad off a large part of the New England coast, although the Gulf Stream is only about 80 miles from Marthas Vineyard and Nantucket. The temperature of these waters, except in sheltered situations, only reaches 60° F. or slightly above for a few weeks in midsummer, and for the greater part of the year is below 50°, and remains below 40° throughout the winter. The explanation of this condition involves a number of factors, which are discussed in section 1, chapter II, pages 35 and 51, to which the reader is referred for details. The most important point for present consideration is the undisputed fact of the presence of a belt of relatively cold water north of Cape Cod, lying between the Gulf Stream and the New England shores, which directly influences the algal flora.

The marine algæ south of Cape Cod may be grouped into what Harvey (1852, p. 26) calls the flora of Long Island Sound, extending from Cape Cod to New Jersey. It includes

a large number of species not found at all north of Cape Cod and some that have been reported only in a few sheltered situations where the temperature of the summer undoubtedly rises much above the average of the general region. It comprises certain species which are present in the north Adriatic and other parts of the Mediterranean and some that are found south of New Jersey, in the West Indies, and in other warmer seas. The generally sandy character of the coast from New Jersey southward serves to separate the flora of Long Island Sound from that of Key West and the West Indies. Certain species that are typically northern or arctic in their habitats are found all the year round in some localities south of Cape Cod where the conditions are sufficiently favorable for their growth, and a number of other species appear in the winter season. However, the algal flora of the summer stands in sharp contrast to that north of Cape Cod, and resembles in many respects the floras of warmer seas, although a number of important groups, characteristic of such regions, are not represented in the flora of Long Island Sound.

The reasons for the peculiarities which are noticed at once in the algal flora south of Cape Cod are in general quite as evident as are those for the boreal characteristics north of the cape. Cape Cod forms a barrier which holds the cold waters of the north somewhat as in a pocket and greatly checks their mingling directly with the waters of Nantucket and Vineyard Sounds to the south. Nantucket and Marthas Vineyard, together with various shoals, form barriers which still further protect these sheltered sounds from the cooler water which lies off such exposed points as Gay Head and No Mans Land. This offshore cooler water is probably an extension of the cold belt north of Cape Cod, which continues southward around the cape. The proximity of the Gulf Stream, which lies only about 80 nautical miles off the coast of Nantucket, is also a factor of considerable importance. While the Gulf Stream does not send any well-marked side currents toward the coast, it must, nevertheless, greatly modify the temperature of the water which lies between it and the shore. It is well known that southerly storms bring surface water from the Gulf Stream toward the coast, for masses of gulfweed, *Sargassum bacciferum*, with animal inhabitants characteristic of sargasso seas (such as the nudibranch, *Scyllæa pelagica*, certain crabs, *Planes minutus* and *Portunus sayi*, and the fish *Pterophryne historio*) are not infrequently found in Vineyard Sound and other bodies of water, especially where tidal currents are so strong as to bring them near to land.

The waters south of Cape Cod, embracing such bodies as Vineyard Sound, Buzzards Bay, Narragansett Bay, Long Island Sound, and the regions that lie between, are then effectively protected from the influence of the cold water north and east of the cape, and consequently are able to become relatively warm during the summer months. The fact that these waters are generally shallow permits them to respond very quickly to the atmospheric changes at different seasons and makes possible great extremes during the year. Their temperature in the winter falls close to freezing point, but rises in the summer to 70° F. and above. Some of the most sheltered harbors and bays may even become much warmer than that during the summer, while they regularly freeze over in the winter. Such a wide range of temperature throughout the year permits a great variety in the life conditions, which is expressed by sharp seasonal changes in the character of the flora. It is the high temperature of the summer which at this season accounts for the development of the characteristic summer algal flora with its resemblance to the floras of southern seas.